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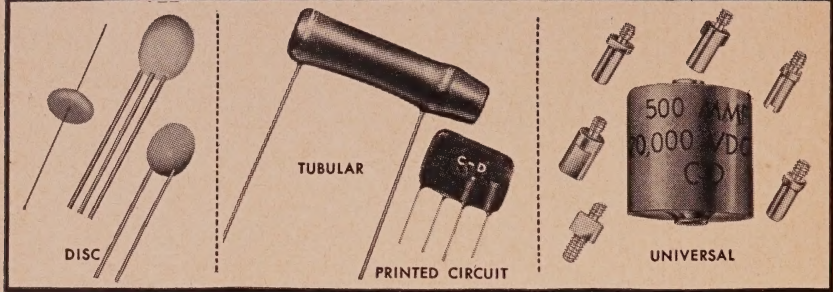

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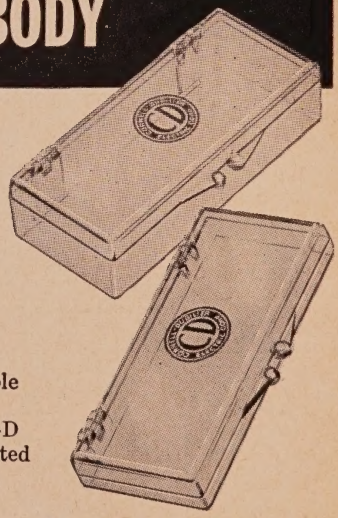

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TRIGGER AND SWITCHING CIRCUITS

Electronic circuits may be considered to be divided into two large groups. The first group includes those which operate continuously over an unbroken range and is typified by conventional amplifiers, modulators, and rectifiers. In these circuits, the output is a replica of the input or control signal. The second group embraces devices which do not provide a continuum of operation or any output signal which resembles the input or control signal, but are **two-state** in nature. That is, they are either on or off, high-output or low-output, positive or negative, etc. The input signal serves only to change the state of these circuits. This latter group of special-purpose circuits are in general the electronic triggers and switches. Their operation often utilizes pulse techniques and often is completely analyzed only in terms of pulse theory.

The great practical importance of electronic switching circuits lies in their high speed. An electronic switch can go into and out of operation several thousand times faster than a good mechanical switch or relay, and can also repeat its operation several thousand times more per second than the best electromechanical device.

The number of trigger and switching circuits has grown enormously since 1940. Aside from their applications in radar and electronic computers, some of these circuits or simplifications of them may be used in other types of electronic equipment. They are handy tools for the experimenter. This article will treat some of these circuits descriptively.

Basic Gas-Tube Circuits

Aside from the simple electromechanical relay, the rudimentary gas-tube circuit is perhaps the best-known 2-state electrical device. Its operation is based upon the fact that the gases with which these tubes are filled have definite voltages at which an electrical discharge and conduction through them can be initiated and terminated. The starting voltage is termed the **ignition potential,** and the turn-off voltage the **extinction potential.**

While the tube is fired, it passes a current; but when it is extinguished, it is almost a complete open circuit. This action permits the gas tube to perform as a switch.

Gas diodes, triodes, and tetrodes may be employed in this manner. Figure 1 shows the basic application of gas diodes. In Figure 1(A), a d-c voltage (E) slightly lower than the ignition potential of the diode (D) is applied through resistors R_1 and R_2. A d-c signal voltage (e) applied to the input terminals of the circuit in the polarity shown will act in series with E. This voltage is so chosen that $E + e$ equals the ignition potential. This signal voltage, e, then causes the tube to fire, whereupon current flowing through the circuit produces a voltage drop across resistor R_2. The tube will remain fired even when the input signal is removed. The current and output voltage continue until there is applied to the input terminals a second signal voltage, e, of opposite polarity and of sufficient amplitude to reduce the diode voltage to its extinction potential, or until switch S momentarily is opened.

The main feature of this type of circuit is that it can be switched-on by a short signal pulse and will remain in operation after the pulse disappears. Furthermore, subsequent pulses of the same polarity, or weak pulses of opposite polarity, will have no effect upon the conduction. In some applications, the coil of a d-c relay is substituted for resistor R_2.

This simple circuit suffers somewhat from low sensitivity and low output voltage. This may be understood when it is considered that the voltage drop across the fired tube is rather high and that the drop across

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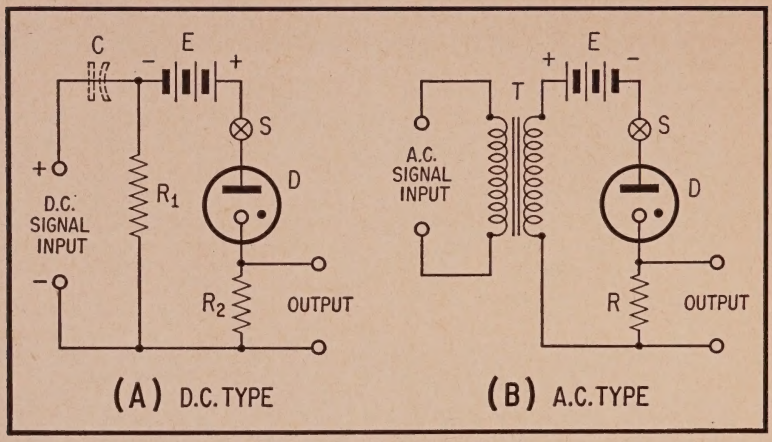


Fig. 1. Simple Gas Diode Circuits.

R_2 is correspondingly small. Also, resistance R_1, across which the input signal is developed and which is necessary for completion of the circuit, must be low enough that its IR drop will be inconsequential. This results in appreciable loading of the input-signal source. However, the circuit is capable of delivering sizeable currents, depending upon the type of gas tube, and this works to advantage when a low-resistance d-c relay coil is used in lieu of resistor R_2.

Some success has been obtained with an r-f trigger signal in the type of circuit shown in Figure 1(A). Radio-frequency current is passed through a coil wound around the outside of the glass envelope of the gas tube. The r-f field fires the gas and the tube then conducts current from the d-c bias source.

In some instances, a momentary a-c control signal will be preferable. This type of signal might be accommodated by inserting a series capacitor, C, in Figure 1(A). In most instances, however, an input transformer (See Figure 1-B.) will be more desirable. The peak-to-peak amplitude of the control signal is chosen such that the voltage on the negative half-cycle added to the d-c bias (E) will fire the tube, but the positive half-cycle voltage will be insufficient to extinguish the gas. In the a-c circuit, the tube continues to conduct until switch S is opened momentarily. Self-extinguishing circuits also have been worked out.

Suitable gas diodes which have been employed in practical switching circuits, such as those shown in Figure 1, include neon and argon glow lamps, VR-type voltage regulator tubes, and some gaseous rectifiers.

Multi-element gas tubes (thyratrons) permit separation of the input and output circuits and in some instances produce higher output currents and afford greater sensitivity.

Figure 2 is the basic circuit of a dc-operated thyratron. Steady anode voltage is supplied by the source E. Initially, the grid is at zero potential and there is no arc in the tube. A d-c signal or positive pulse equal to the critical voltage of the thyratron, applied to the signal input terminals, will fire the tube. Anode current then flows from source E through resistor R and will continue to flow even after cessation of the signal pulse. The resulting voltage drop across resistor

R may be used as the on-state output signal. In some applications, resistor R is replaced with a d-c motor, solenoid, lamp, heater, or the coil of a d-c relay.

Thyratrons range in size and capability from small triodes like the familiar 2D21, 884, 2050, and 2051 to industrial types capable of passing extremely high anode currents.

Gas-tube circuits represent the simplest combinations for electronic switching. In these circuits, initiation of the output current or voltage coincides in phase with the leading edge of the trigger signal, and the output is sustained until a disabling pulse subsequently is applied or the circuit momentarily interrupted. Various time-delay and phasing schemes are possible for delaying the output signal. Self-quenching circuitry also is possible, to terminate the output signal a desired time instant after cessation of the input trigger pulse.

Transformer as Triggering Device

In passing, the utility of the ordinary transformer should be mentioned as a simple triggering device in conjunction with sustained d-c input signals.

A steady dc applied to the primary of a transformer has no effect, except that a pulse of one polarity will appear across the secondary when the steady primary current suddenly starts.

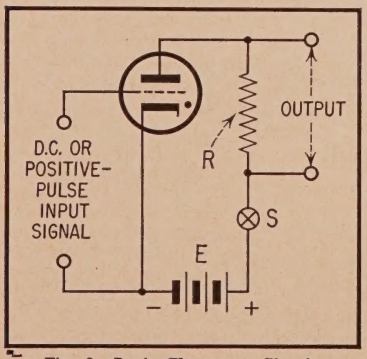


Fig. 2. Basic Thyratron Circuit.

And when the primary current suddenly stops, a voltage pulse of the opposite polarity will appear across the secondary. The secondary voltage is zero between these pulses. A diode poled correctly in series with the secondary winding and the output load circuit may be used to separate pulses of one polarity from those of the opposite polarity.

This transformer action occasionally offers a simple means in a complicated circuit to obtain an actuating pulse coinciding in time either with the beginning or ending of the flow of a steady d-c reference signal. The signal might, for example, be the rectified component of a carrier.

Repetitive Switch

Where continuous electronic switching at a predetermined rate is required, provision is made for operating a gate at the desired frequency. Gate is another name for switch. Technically, an electronic gate is a circuit which permits passage of one signal onlv when it has a certain relationship to a control signal. The gate may open or close, for instance, when the two signals are in phase, or being in phase have a certain amplitude ratio.

The amplifier stage including tube V_1, in the upper half of Figure 3, acts as a gate, transmitting or blocking the input signal. The multivibrator (V_2 and V_3) in the lower half of the circuit opens and closes this gate at a frequency determined principally by the values of C_3, C_5, R_4, and R_7.

In the multivibrator, the two tubes conduct and cut off alternately. When V_3 is conducting plate current, this current produces a voltage drop across resistor R_2 sufficiently high to bias V_1 to cutoff. This blocks transmission from input terminals 1-2 to output terminals 3-4. When plate current is cut off in V_3, the high cut-off voltage is removed from R_2, and the gate tube (V_1) is no longer disabled. The signal then is transmitted readily from terminals 1-2 to terminals 3-4. As plate current in the multivibrator

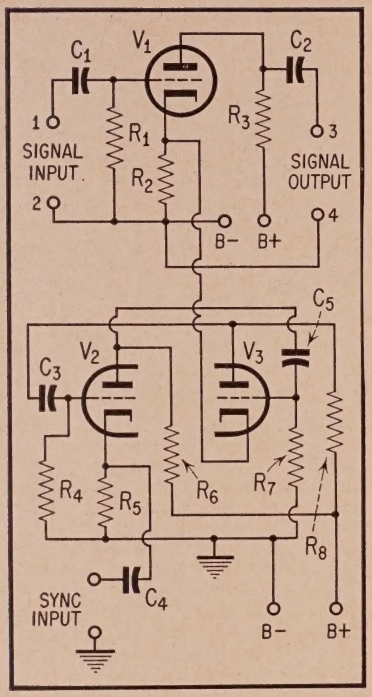


Fig. 3. Repetitive Switch.

shifts back and forth between V_2 and V_3, the gating tube alternately transmits and blocks the signal.

Due to the sharp on-off action of the multivibrator, the voltage drop produced across R_2 by V_3 essentially is square in waveform. This causes V_1 either to be turned on or off, sharply in true switch fashion.

Stability of the multivibrator may be enhanced by injecting a suitable synchronizing voltage at the SYNC INPUT terminals. Synchronization may be introduced also at the grid or plate terminal of either V_2 or V_3.

This basic principle of intermittent switching at high rates is employed in the electronic switch used to display several signals simultaneously on the screen of an oscilloscope.

Single-Shot Blocking Oscillator

Somewhat simpler than the multivibrator and using fewer components, a blocking oscillator may be arranged to deliver a succession of timed pulses which may be employed to trigger electronic switching circuits.

Figure 4 shows a typical circuit of this type. Here, the coupling between plate and grid coils of the transformer is tight enough to produce true blocking oscillator action. The values of capacitor C_1 and grid resistor R are chosen such that the circuit will cease oscillation after one or more cycles, and after a resting interval will again deliver one or several cycles, repeating the process cyclically. The resulting output is a series of bilateral pulses similar to those shown at the output terminals in Figure 4.

Circuit action is based upon the fact that close coupling between the plate and grid coils causes the tube grid to be driven highly positive by the inductive feed-back. While positively charged in this manner, the grid attracts electrons in copious numbers and these electrons collect on the left plate of capacitor C_1. When R is chosen large with respect to C_1, considerable time will elapse before these electrons can leak from C_1 through resistor R. The high negative voltage

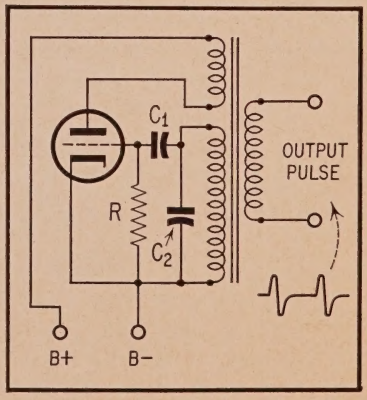


Fig. 4. Single-Shot Blocking Oscillator.

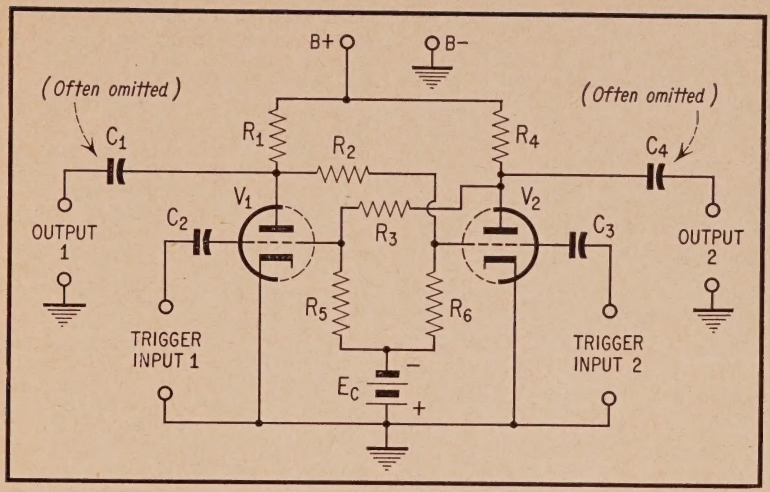


Fig. 5. Eccles-Jordan Flip-Flop Circuit.

due to the collection of electrons biases the tube beyond cutoff and thus disables the oscillator. After an interval governed by the C_1R time constant, the capacitor becomes discharged, the tube no longer is cut off, and another pulse of oscillation occurs.

From this action, it is seen that the output-pulse width is determined by the frequency of oscillation (period of one half-cycle), and the separation between output pulses is governed by the C_1R time constant.

While both positive and negative pulses appear at the output terminals of the circuit, one may be separated from the other, when desired, by means of a diode poled to pass the required pulse.

Vacuum-Tube Flip-Flop

The Eccles-Jordan multivibrator, commonly known as the **flip-flop** circuit, is a basic element in many modern electronic devices such as computers, counters, scalers, and some sweep circuits. Figure 5 shows the basic arrangement of this type of circuit.

In the flip-flop, like other multivibrators, one tube conducts plate current while the other is cut off. The application of a suitable trigger pulse to the appropriate grid shifts the other tube into conduction and cuts the first one off.

The flip-flop is convenient as an accurate "count-down" device, since one tube in the pair has output only at each second successive triggering pulse. Each tube therefore is a frequency halver for the trigger repetition rate. A cascade of flip-flops may be employed to divide very high frequencies to low enough rates to be measured with mechanical counters. A division of 2 is obtained in each stage of the cascade. This technique is employed in radiation counting equipment and in some frequency meters.

Performance of the flip-flop circuit shown in Figure 5 may be explained in the following manner: When the power first is switched on, chance transients will cause one tube to conduct with slightly more plate current than the other. Let us assume that V_1 has the higher conduction. The plate-cathode voltage of V_1 then is some-

what lower than the supply voltage because of the drop in R_1. This lowered plate voltage causes a less-positive voltage to be applied to the grid of V_2 through the voltage divider R_2-R_6. A less-positive grid voltage increases the plate-cathode voltage of V_2, and this in turn makes the grid of V_1 more positive through the voltage divider R_3-R_5. This causes V_1 to draw even more plate current, and the grid of V_2 becomes even less positive. This action continues, driving V_1 rapidly to high conduction (limited only by the resistance of R_1) and V_2 to cutoff. This is one of the two stable states of the flipflop.

Now, if a negative pulse of sufficient amplitude and short duration is applied to the TRIGGER INPUT 1, this negative voltage at the grid of V_1 will reduce the plate current of that tube. This momentary reduction of the plate current of V_1 will reverse the sequence of events just explained. This drives V_1 rapidly to cutoff and V_2 to high conduction. Further negative pulses at TRIGGER INPUT 1 will have no effect. This is the second stable state of the flip-flop. A positive trigger pulse applied to TRIGGER INPUT 2 would have accomplished the same purpose.

The output signal may be taken from either or both tubes, as shown in Figure 5. The two outputs are, of course, out of phase with each other. That is, one is "on"; the other "off." The output coupling capacitors (C_4 and C_4) are omitted in some systems where the low (off) and high (on) d-c plate voltages are used directly as the output signals.

With the circuit exactly as shown in Figure 5, a constant-polarity trigger pulse must be applied successively to TRIGGER INPUT 1 and TRIGGER INPUT 2 in order to shift the flip-flop from one state to the other, although only one of the outputs may be used, if desired.

From the foregoing explanation, it can be seen that each tube is in the switched-on condition only half of the time when a succession of pulses is applied to the circuit. The output of a single tube thus exhibits only half

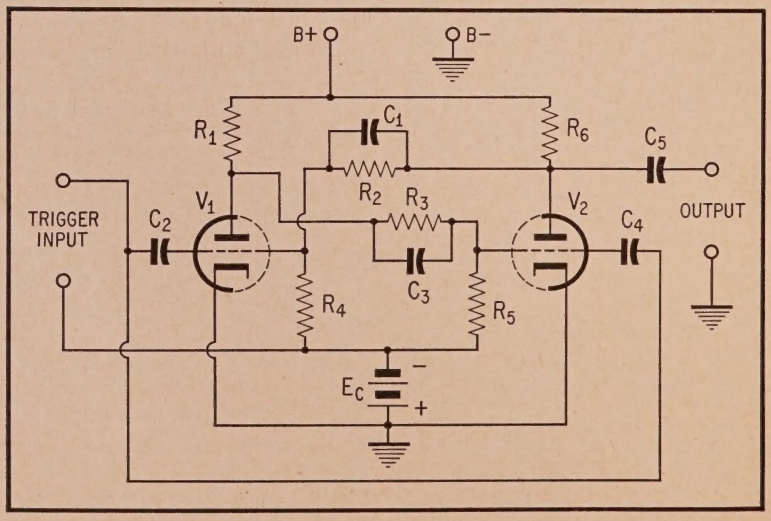


Fig. 6. Flip-Flop with Common Triggering Input.

of the triggering rate. This is why the flip-flop is able to divide the trigger-pulse rate by 2.

Very often, trigger pulses of only one polarity are available for operating a flip-flop. Yet, it is desired that they be applied to the circuit without switching from one input to the other. Figure 6 shows a modified flip-flop circuit for this purpose. Negative trigger pulses applied successively to the single pair of TRIGGER INPUT terminals switch conduction alternately between V_1 and V_2. Thus, the single OUTPUT terminals deliver one output pulse for every second trigger pulse.

This action is obtained by connecting the two input capacitors, C_2 and C_4, together and providing "commutating" capacitors, C_1 and C_3, across the coupling resistors, R_2 and R_3. With equal trigger pulses applied, as they are in this circuit, to each tube grid simultaneously, the circuit would tend to stall. However, capacitors C_1 and C_3 prevent this by conducting a large pulse to the opposite grid to offset the effect of the input trigger pulse at that grid. Thus, one trigger pulse flips conduction from one tube to the other, and the next trigger pulse flips it back again.

One-Shot Multivibrator

Figure 7 shows two circuits which are somewhat similar to the flip-flop but have the property of single-shot operation. Application of an input triggering pulse causes a single output pulse to appear, whereupon the circuit flips back to its original state after a predetermined time interval. The length of this interval is determined by the circuit constants, and insures that each output pulse has the same width regardless of the duration and amplitude of the input pulse. This property enables the one-shot multivibrator to be used to convert pulses of random width into those of uniform width.

The circuit in Figure 7(A) operates in the following manner: Tube V_1 is biased to cutoff by d-c grid bias E_c and thus has no, or very insignificant, plate current. V_2 conducts heavy plate current because its grid is returned to B-plus through resistor R_4. This is the stable state of the circuit. When a positive trigger pulse of sufficient peak amplitude is applied to the TRIGGER INPUT terminals, the negative bias on V_1 is reduced and causes this tube to conduct plate current. This action lowers the plate voltage of V_1, allowing capacitor C_2 to begin charging through resistor R_4. This, in turn, causes a progressively less positive voltage at the grid of V_2 (due to the drop across R_4) which reduces the plate current of that tube and eventually cuts it off. The condition of V_1 conducting and V_2 cut-off is the **unstable** state of the circuit.

Near the end of the charging time of C_2, the voltage drop across R_4 falls too low to keep V_2 cut off. As V_2 then begins to conduct, its plate voltage falls to a lower positive value. This is a **more-negative** voltage and it is coupled to the grid of V_1 through the voltage divider R_1-R_2, causing V_1 to pass less plate current. The circuit returns to its stable state with V_1 cut off and V_2 conducting. The C_2-R_4 time constant determines how long the circuit remains in its unstable state and accordingly the width of the output pulse.

In Figure 7(B), the two tubes are coupled through the common cathode resistor, R_5. With V_2 conducting heavily, the voltage drop across R_5 is sufficient to bias V_1 to cutoff. This is the stable state of the circuit. A positive pulse of sufficient amplitude applied to the TRIGGER INPUT terminals will overcome the high bias and cause V_1 to conduct. The lowered plate potential of V_1 then causes C_2 to charge through R_2, and the voltage drop across R_2 biases V_2 to cutoff. The decreasing V_2 plate current, with increasing cutoff voltage, reduces the voltage drop across R_5, and the circuit assumes its unstable state with V_1 conducting and V_2 cut off.

Here, as in the preceding example, as capacitor C_2 becomes fully charged,

the voltage drop across R_2 falls too low to keep V_2 cut off. The increasing plate current in V_2 then causes an increasing voltage drop across R_3 and this voltage eventually biases V_1 to cutoff, the circuit returning to its original stable state. The C_2-R_2 time constant determines the length of time the circuit remains in its unstable state, and accordingly the width of the output pulse.

Additional Arrangements

Flip-flop, gating, one-shot, blocking oscillator, and multivibrator action also have been obtained with circuits similar to those described in this article but utilizing transistors, gas diodes, reverse-biased germanium diodes, magnetic amplifier elements, and dielectric amplifier elements.

A good rule of the thumb is that a device or component may be employed as a flip-flop or one-shot element provided its response characteristic exhibits both stable and unstable regions. The condition necessary for flip-flop action is that the response curve show two well-defined stable regions separated by an unstable region. For one-shot action, there can be one stable and one unstable region.

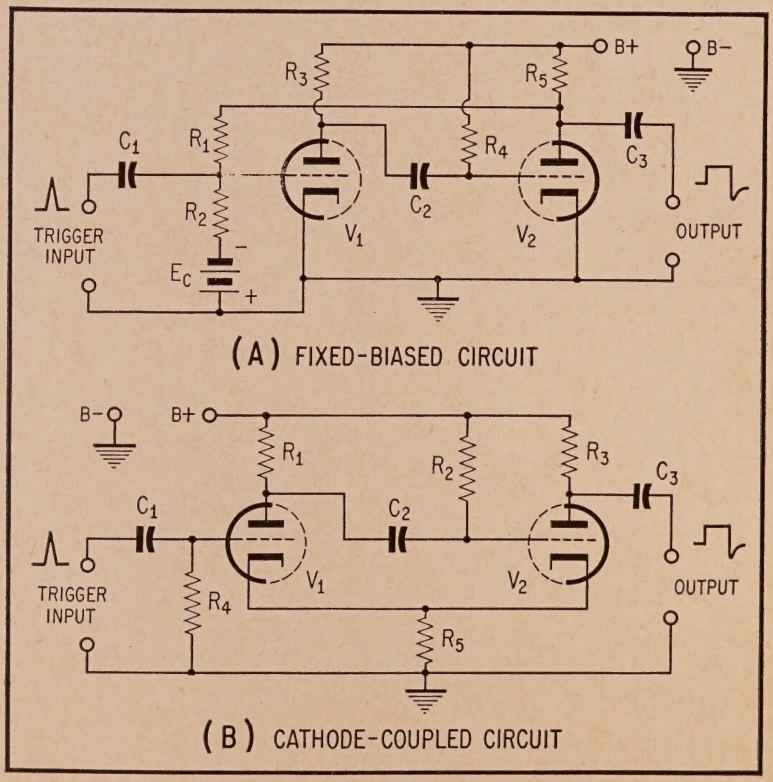
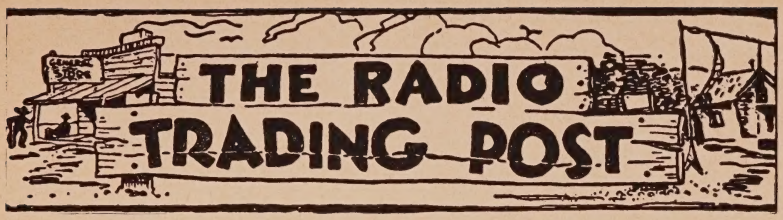


Fig. 7. One-Shot Multivibrators.



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FOR SALE — Riders TV manuals 1-7 in good cond., $10 each plus express charges. Bill Wapniak, 889 Hunts Point Ave., Bronx 49, N. Y.

SWAP — Riders 1-5 (abridged) and 6-15, for 17" TV set in good working order. Prefer RCA, Philco, Zenith, with cascade tuner. Schrader's Radio & TV Service, 301 South 18th St., Escanaba, Mich.

WANTED — Back issues NRI "National Radio News" prior to June, 1949. State how many issues and price. C. H. Bell, 707 Beech Ave., Charleston 2, W. Va.

WANTED — Used, low-priced tube checker, state model, cond., age, and price. Jim Vetter, 206 Gould St., Beaver Dam, Wis.

FOR SALE — Fedder dehumidifier (floor sample) $55; Sabersaw with tilt-top table and motor, A-1 cond., $20. Will ship freight collect. Hartman Radio & Television, 63-04 Broadway, Woodside 77, N. Y.

FOR SALE — Heath TS-3 sweep gen., $50; Precise 9071 VTVM, $50, both wired and tested; rotary converter, 110 v. DC to 110 v. AC, 60 cycles, 300 w., $30. All perf. cond. Want Ballantine AC voltmeter. S. Friedland, 140-35 Franklin Ave., Flushing 55, N. Y.

FOR SALE — Heathkit SG-8 sig. gen., built and tested with manual and test leads, $24. Edwin C. Eisenbeis, 2813 Sheila Dr., Louisville 5, Ky.

WANTED — Sams 100-250 for cash, or trade 21" TV console or test equip., mobile amplifier with 78 rpm phono, 110 AC-DC or 6 v. DC, 2 horns and drivers, mike. Robert Abel, 851 Main St., Holyoke, Mass.

FOR SALE — 2-color neon background sign, 11" x 24". Print your message on front glass, green scintillating edges, complete with transformer, $10; Webster model 133 record changer with removable metal base, can be converted from 78 to 33⅓ rpm, $15. G. H. Doty, 1036 South Broadway, Dayton 8, Ohio.

FOR SALE — Eico 7" scope, l. n., $85; Hickok 288X, $95. John A. Kimm, 934 Judson St., Evansville 13, Ind.

FOR SALE — Recorder-Scanner BC918B; xmitter rcvr. BC659H; 522 complete, TR4, 500 mc. rcvr. with lighthouse tubes, frequency deviation meter; RCA 3" scope; Sprague KT-1 Quick test. Dr. M. J. Fink, 85 W. 104th St., New York 25, N. Y.

FOR SALE — Zenith radio for 1947-1948 Mercury, 1. n., with tubes and vibrator, $20; 7JP4, 10BP4 with yoke, focus coil, ion trap, all $7.50; Dow coax relay, 117 v. AC coil, $5. Mike Peterhans, Pond Farm, Guerneville, Calif.

FOR SALE — All-band exciter unit Sonar model VFX-680, with tubes, coils, instruction manual, in perfect cond. Al Witzl, 1645 Campbell Ave., Des Plaines, Ill.

SELL OR SWAP — BC221 freq. meter; BC639 rcvr.; 100TH's; 4-65A's; 4X150A, H.V. supply components; Panadaptor for surplus gear; meters; coax cable; Elmac mobile. G. Pasquale, 9421 Thornhill Rd., Silver Spring, Md.

FOR SALE — Like new E-200C sig. gen., never used, $40. John Erdman, Webster, S. Dak.

SELL OR TRADE — Heathkit TS1 TV alignment gen.; Hickok 155 indicator traceometer; Precision 832S pocket VOM; Eico 425 5" scope; Superior 400 VTVM; Philco 050 tube tester. Cash or communication rcvr., xmitter. John A. Berry, 5802 Master St., Philadelphia 31, Pa.

SELL OR TRADE — Mutual cond. tube checker, voltohmeter, Solar Exam-meter, 6 v. DC power supply, Precision sig. gen., Riders and Sams, resistors, tubes, capacitors. Desire photographic equip. Steve Rogowski, 4212 So. Talman Ave., Chicago 32, Ill.

FOR SALE — HQ 140X, 1. n., 522-2 meter trans, power supply and mike; Eico 320 sig. gen. factory built; Gardiner code machine with 10 tapes, 1. n., Riders 1 to 14; Gonset conv. A. Turturro, 146-26 No. Hempstead Tpke., Flushing, N. Y.

FOR SALE — NC-57 rcvr., 1. n., $50. E. P. R. 1 Box 46, Junction City, Ore.

SELL OR SWAP — 813's, HF100's, HF300's, 872A's 832's, 829's, 869B's, others. Weeks, 605 Hughes Ave., North Cape May, N. J.

FOR SALE — Xmitter parts: plate and filament xformer with two WL468 rect. tubes and two 966A xmitter tubes, sockets, tank coils. Want S95 Hallicrafter rcvr. W. E. Fuller, 3137 W. Michigan Rd., Dimondale, Mich.

TRADE — (5) 7.10 x 15 Goodyear Blowoutproof tubes, value $75, 1. n., for 12 v. Heathkit BE4, assembled or not. R. M. DeFina, 884-58th St., Brooklyn 20, N. Y.

WANTED — Johnson "matchbox"; Johnson low pass filter and standing wave ratio bridge. State price. Dom DeVito, 15 Smith St., Stamford, Conn.

FOR SALE — Precision E-200-C sig. gen.; Mallory 6RS10 power supply; No. 944 Eico flyback and yoke tester, factory wired; Standard coil tuner plus tubes, TV parts, schematics, etc. Steve Weichsel, 209 Third St., Passaic, N. J.

FOR SALE — Police alarm FM rcvr., 152 to 163 mc., exc. cond. Best offer. R. Weakley, 86 Wendell St., Providence, R. I.

WANTED — 3" Pilot TV, any cond.; 3KP4 tube; 152 mc. FM PA rcvr. Will pay cash. C. J. Fritz, 2816 F St., McKeesport Pa.

FOR SALE — Surplus electronic gear; old tubes (for collectors). George Oelkers, Jr., 222 N. Lemon St., Anaheim, Calif.

SELL — Handbooks: ARRL 1946, '48, '49, '52, $1.35 ea.; Radio Handbook 11th Ed., $2.25; TV for Radiomen by Noll, $6; 187 QST's; 49 Radio and TV News. Make offer, all postpaid. M. J. Marshall, 455 Washington Ave., Dumont, N. J.

FOR SALE — TV or Hi-Fi cabinet with blank face in mahogany, 1. n., $25; 45 rpm wireless record player, $8; 1 hp. 220-440 v. motor, $25. Anthony O. Vanone, 137 Burhans Ave., Haledon, N. J.

SWAP OR SELL — Jefferson-Travis UF1 Ultra short wave transceiver, complete with handsets, 53.5-76 mc.; Motorola T69-20A transmitter and power supply, mobile with cables plate mod., 6L6 driving an 807. S. J. Feller, 3109 Brighton 7th St., Brooklyn 35, N. Y.

FOR SALE — 12" Transvision DeLuxe TV with inputuner, $50. J. Israel, 296 Wainwright St., Newark 8, N. J.

FOR SALE — Table model radio-phono-recorder combination, $35; musical instrument amplifier, two inputs, and extra speaker outlet, $25. John Graf, 2024 14th St., Moline, Ill.

FOR SALE — RCA 39A TV crystal calibrator, $85; model 39B, $125; RCA 3" scope WO 57A, $85. Vincent Iavarone, 1218 Leland Ave., Bronx 72, N. Y. C.

FOR SALE — Solar CE capacitor analyzer with leads and manual; Zenith H-500, l. n. Transoceanic portable radio with spare set of tubes. Make offer on each unit. Harlan Bercovici, 3322 N. 48 Ave., Omaha 4, Neb.

FOR SALE — Phono-amplifier kit with power xformer, speaker, output xformer 3 tubes, filters, condenser, resistor sockets volume control, jack, $5 FOB. A. Palermi, 223 S. Winebiddle Ave., Pittsburgh 24, Pa.

FOR SALE — Two Matchlett ML-357B tubes, never used, $50 each. H. Reed, 1347 S. Capitol St., Washington 3, D. C.

TRADE OR SELL — Rider's TV manuals, 1-5 in exc. cond. Best offer. Nick's Radio, 169-10 140 Ave., Springfield, Gardens 34, N. Y.

FOR SALE — NRI VTVM, $10; 20 w. amp., $15; 3 w. amp. kit and diagram with AC power xformer, less speaker, $7.50 FOB. A. Agostino, 2230 S. Winebiddle Ave., Pittsburgh 24, Pa.

FOR SALE — 40 DeForest Radio and TV Servicing lessons with 60 Fundamental Electronics lessons. Best offer. Wm. Weinerth, 4211 4th Ave., Temple, Pa.

SELL OR TRADE — DeForest TV and Radio home course, l. n., complete with parts and test equip. Best offer. Richard L. Lint, 1223 Grant St., Elkhart, Ind.

SWAP — Used juke box amplifiers, records, tubes, tools, parts for TV test equip. and radio or TV books. Prefer local. A. Abramowitz, 599 W. 176th St., New York 33, N. Y.

FOR SALE — Gonset tri-band converter, PE-101C dynamotor 100% converted, mastermobile 20 meter ant. and mount, mobile mike with cables, $60; Crown TV ant. ratator, $20. James Hurst, 337 S. Main St., Wallingford, Conn.

SELL OR TRADE — Heathkit sig. gen., sig. tracer, tube checker, vibrator tester. Trade for Riders or Sams. Roy's Radio and TV Shop, Callis Road, Victoria, Tex.

FOR SALE — Isolation xformer (Chicago): IS-250 w., pri. 105-115-125, sec. 125-115-105, sl. switch, fem. outpt. recept., electrost. shield. 18¼ lbs., l. n., $12.50. H. M. Lester, 101 Park Ave., New York 17, N. Y.

WANTED — Zenith table model FM (only) rcvr. model 7H91B. Geo. A. Cahill, East Dennis, Mass.

SELL OR SWAP — Oil-filled capacitors, all 600 v. DC: 10 mfd., $1; 6 mfd., 50c; 3 or 4 mfd., 25c, all less mounting brackets; 5 mfd., 75c with brackets, FOB. Bill Blackwell, Box 355, Desloge, Mo.

FOR SALE — Howard 482 FM tuner, $20; Emerson 508 personal portable with batteries, $12; Anchor 2-stage booster, $6; Alliance 2-tube booster, $6; De Mornay Budd solenoid flash gun, exc., $15. Chandler Waterman, 703 Pleasant St., Athol, Mass.

SELL OR TRADE — Heath VTVM model V4A; Feiler stethoscope model TS-3A; dynamotor Bendix 28 v. DC to 300 DC; West. Elec. hearing aid. Fred Welch, 845 Allingham St,, Van Wert, Ohio.

SELL OR TRADE — Like new printed circuit kit; Eico 221 VTVM; Eico 320 sig. gen.; Heath T-3 sig. tracer; Heath capacitor checker, C-3. Instructions for all. Francis J. Stifter, Rm. 244, Douglass Houghton Hall, Houghton, Mich.

FOR SALE — Eico scope 425, factory assembled, slightly used, $35. Charles Clark, 230 West 150th St., New York 39, N. Y.

FOR SALE — Amateur radio 75 w., 80, 40 meter xmitter, uses 6AG7 osc., 6L6 amp., pair 807's final. Complete, exc. cond., $35. Gene M. Augustine, Fenton, La.

FOR SALE — EMC model 106 VTVM, $25; NRI electronic multitester with AC-RF head, $15. Both l. n. Cecil R. Wallace, R. 4, Albertville, Ala.

SELLING OUT — RCA TV test equip. and other name brand items far below cost. State your wants, surprising price will be quoted. Lyle M. Parks, 1701 Elizabeth St., Bay City, Mich.

WANTED — Meissner analyst or RCA Rider chanalyst, give model and cond. John Zachik, 1031 Fabian Way, Sharon, Pa.

SELL OR SWAP — AM-FM radio 88-108 mc, $20; 184 Photofacts folder, $1. Geo. G. Moll, 1118 Music St., New Orleans, La.

SELL OR TRADE — Auto radios, 1946 and up, custom built, all A-1 cond., $15, or trade for test equip. Best Radio-TV, 3349 Fulton, Cleveland, Ohio.

SELL OR SWAP — NRI VTVM with AC-RF head, $25. Want Heath C-3 condenser-checker. D. Stuart Pinnell, 7611 Eastern Ave., Takoma Park 12, Md.

WANT — 1951 Chevrolet radio. State cond. and price. James G. Wagner, R. 2, Box 202, Hummelstown, Pa.

FOR SALE — ATR inverter model RHD 250 w. in good cond. Any reasonable offer. S. Greene, 24 University Pl., New York, N. Y.

FOR SALE — Volumes 1 thru 10 of Sams Photofacts, l. n., $150. Ed Borkowski, 4218 E. North St., Tucson, Ariz.

SWAP — Sub-min. tubes, sockets, and parts, Atwater-Kent power supply, ADJ, "B," 2.5, 5.0, and 6.3 v. fil. advance ant. relay. Want ham or test equip. Howard Keller, 610 Oceanpark Ave., Bradley Beach, N. J.

SELL OR TRADE — Hallicrafter rcvr. S-38C, l. n., $37 or trade for equal value in TV, and radio tubes. Bud's Radio-TV, Port Townsend, Wash.

WANTED — SCR625 mine detector, with manual. Will swap car radio, duplicator, books. John Haynes, Doe Run, Mo.

SWAP — 3-speed record changer, comm. rec.; booster, tenarotor, tubes. Need camping or fishing equip., .22 pistol or ? Thos. R. Rohland, RR 3, Martinsville, Ind.

WANTED — Good tape recorder, good 3-speed record changer, 250 w. isolation xformer. Give lowest delivered price. Alvin Ladner, Eureka, S. Dak.

FOR SALE — Collector's item, Atwater-Kent model 32 with Rola speaker orig. tubes, perf. cond. Elmer Robertson, Fairfield, Mont.

FOR SALE — All Heath: TS3 sweep gen. factory calibrated, $35; 07 scope, demod., and LO-C probes, $40; V4 VTVM, PP, RF probe, $20, incl. all leads, manuals. You pay shipping. Ike's Radio-TV, 6655 Main St., Cass City, Mich.

SELL OR TRADE — 733D rcvr, complete with tubes and control box, A-1 cond., $15. ME Radio and TV, Box 6042 ESS, Flint 6, Mich.

WANTED — Scope. Advise model, cond. and price. A. Adams, 719 Park Ave., Williamsport, Pa.

TRADE — Slightly used shopsmith (cost $224) for commerical xmitter. Will consider mobile equipment. Local. E. Manchester, 499 St. Lawrence, Buffalo 23, N. Y.

POSITION WANTED — RCA Institutes graduate, first phone license, some broadcast exp., 2 years' TV servicing desires permanent position with good future. Prefer broadcast field, or good electronics firm as technician. Will travel. J. Greenberg, 2234 Ocean Ave., Brooklyn, N. Y.

FOR SALE — Riders rvcr. manuals 10 to 18 except vol. 17 in exc. cond. Garret Brokaw, 214 Virginia Ave., Modesto, Calif.

FOR SALE — Victor 16 mm sound-silent movie projector, model 40B, complete with speaker (2 cases), cable, $100. Don Y. Yen, 317 Northland Drive, Rockford, Mich.

SELL OR TRADE — Dumont tuner, 5 bands, 4 short-wave, 1 broadcast with Hi-Fi amplifier, $25; Detrola table radio 3 bands, AC-DC, $10. Want 8 mm projector or small comm. rcvr. R. Garcia, 300 W. 17th St., New York 11, N. Y.

WANTED — Sams Photofacts above No. 101 state if in binders. Also want QST's for years 1952-53-54. R. W. Daniels, 1418 Division St., Hopkins, Minn.

FOR SALE — 3 elem. 20-mtr. beam, $42; S40A, $65; HQ129 A-1 cond., $125; S.G. modulator complete with mike, $18.50, Meissner EX with FMX, $40. Paul Bittner, Stewartville, Minn.

SELL OR SWAP — Pair of new 832A's never had fil. voltage applied, and Army TU-5-B tuning unit. Make offer. Richard Hadley, 368 Westmoreland Rd., Snyder, N. Y.

SELL OR TRADE — NRI radio-TV course of 122 books without kits, $20. Want binoculars or 35 mm slide projector. A. Cortese, 2431 Crotona Ave., New York 58, N. Y.

WANT — Good portable or small radio. Will trade man or woman's 17J wrist watch. Levriett, Box 3542, Sta. F., Jacksonville, Fla.

TRADE — 814, 100TH's, 803's, 211's, 304 TL, 3BP1 ARC-5 (6-9 mc.), BC-522, NC-150 neut. cond., WE-600 A mike for Q meter, grid dip osc., AM-FM sig. gen., audio Osc. Hopkinson, Box 921, Charlottesville, Va.

FOR SALE — Turner 22X mike, $7; Sig. Corp. SSO-1 code oscillator amplifier, $10; tubes, 25c each; 20 lbs. assorted parts, $5. All for $25. Britt Simons, 150 W. Washington La., Philadelphia 44, Pa.

FOR SALE — Mallory Vibrapak VP-555 in exc. cond., $20. J. Endlich, 759 Brooke Circle, Morton, Pa.

TRADE OR SELL — Frequency meter, FM 50 w. station, sig. gen., TBS-50, for Ham equip. or comm. receiver. Mel Stricker, 65 Southern Ave., Dorchester, Mass.

POSITION WANTED — Radio repair man, several years' experience wishes job with radio repair shop for inside work only. No driving. Alexander Zeitlin, 308 Pacific St., Bridgeport 4, Conn.

FOR SALE — Like new, Ebco CRT TV picture tube checker and reactivator, complete with instructions, $16 post paid. Charles L. Culley, Melville, La.

FOR SALE — Heath S67 sig. gen. factory calibrated, never used, Supreme manuals: 7 thru 14; TV 5 thru 8. Want Sam's Binders, also Photofacts above 245. Redd's Radio and TV Service, Box 12, Union Furnace, Ohio.

FOR SALE — Leece-Neville Alternator, 7 v. AC with rectifier, meter, voltage regulator, replaces conventional gen. for mobile operation, $35 plus transportation or trade for 3-speed turntable, (Garrard or equivalent), Hi-Fi amplifier. R. L. Norman, 212 North 67th Pl., Birmingham, Ala.

FOR SALE — For highest offer, all A-1: Globe King xmtr model 275 with coils for all bands and Bud VFO; BC 342 rcvr., Eldico TR75 TV xmtr, neatly wired, $35; Gonset 3-30 mobile converter. Troy D. Spencer, Bassett, Va.

FOR SALE — RCP test equip., VOM model 411; tube tester model 300; master analyst model 504, $15 each. Samuel Ferraro, 5025 54th Pl., Hyattsville, Md.

WANTED — For cash, Bell model RT-65-B, 3-speed tape recorder, used but in good cond.; state price and cond. William B. Eddy, Gen. Del., Sycamore, Ill.

SELL OR SWAP — Approved model 710 FM-AM tuner with power supply. Make offer or swap for Leica Imarect Universal viewfinder or used telephoto lens paying reasonable difference. Ready for shipment from Miami, Fla. No import duties. Muniz CO-2-MU Box 3118, Havana, Cuba.

POSITION WANTED — Radio-TV Serviceman, 15 years' experience, desires full-time employment in good reliable co. Prefer Minnesota area. Glenn F. Coffin, 574½ Chestnut St., Dubuque, Iowa.

SELL OR TRADE — Bell amplifier model 3705, 2 inputs, 8" Jensen speaker in one unit; 4" micrometer with 3 extensions, l. n.; automatic Trela changer. Need good 7JP4 tube, used table TV. Howard Blair, Box 158, Mooers, N. Y.

FOR SALE — HQ-129X with speaker; Elmac rcvr. with power supply; 120 v. xmitter; Carter 500 v. dynamotor; Prop pitch motor; Selsyns; misc. components. Paul A. Hermle, 248 Upland Dr., Rochester 17, N. Y.

WANTED — Gonset converters, fixed 2-way mobile units, xmitters, amplifiers PA 110 v. or 6 v., trumpets, drivers. State cond., type, make, price. Hike's Sound Service, 810 Ake Road, Fort Wayne, Ind.

WANTED — Stamp collections and accumulations. Trade: ARC-5 broadcast rcvr.; Carter dynamotor 6 v. input at 530 v., at 220 ma. output; Riders 1 thru 14; QST's in binders 1936 thru 1943. Snow, 1011 N. Forrest, Altus, Okla.

FOR SALE — IRE Proceedings complete since 1930, $50. Plus shipping, or will trade for 35 mm camera. Wm. C. Simon, 149 President St., Lynbrook, N. Y.

SELL OR SWAP — 10 and 20 meter 25 w. xmitter with dynamotor and relays plus Morrow tri-band rcvr. and ant. in good operating cond. for $50, FM tuner, or 35 mm slide projector. Local preferred. David Barlin, 257 Red Maple Dr., So. Levittown, L. I., N. Y.

SWAP — 500 ft. 18 copperweld antenna wire; FTR "Reference Data for Radio Engineers" (3rd ed.), and Terman's "Radio Engineer's Handbook," all l. n., for Heathkit VFO. T. H. Mackintosh, Box 655, Elon College, N. C.

WANTED — Riders, Sams, tubes, condensers, resistors, used radios, test equip. for cash. Swap 15,000 Raleigh coupons and radio cabinets. Frank Kesto, R. 1, North Rose, N. Y.

FOR SALE — UHF and VHF antenna, with 10 ft. mast, 60 ft. of line, hardware and instructions. Can be used for both. Elements swing to any 3 positions. A-1 cond., $15. Daniel Seidler, 4216 S. Washtenaw, Chicago 32, Ill.

FOR SALE — Webster-Chicago 56-8 record changer, 78 rpm; G. E. variable-reluctance cartridge with diamond stylus, gentle push-off action, 4-pole motor, exc. cond. No reasonable offer refused. Philip Greenspun, 76 Pomona Ave., Newark 8, N. J.

FOR SALE — Hickok 650-C Videometer, l. n. No swap. $195, a real bargain. H. P. Weiss, 118 Dayton Ave., Kalamazoo, Mich.

FOR SALE — National NC-200 with spkr., $100; Millen R-9'er with 20 meter coil, $10; BC-453 with power supply, $15; BC-946B covers broadcast band, $10. A. Brocato, 1631A Valley Ave., Birmingham, Ala.

FOR SALE — Best reasonable offer takes Riders radio manuals 1 thru 15 in exc. cond. William O'Neill, 128 Willow St., Plymouth, Pa.

FOR SALE — Instructograph with tapes and instruction book, exc. cond., $10. Bernard Annenberg, 286 Eastern Pkwy., Brooklyn 25, N. Y.

SELL OR TRADE — Tube tester built to Mechanics Illustrated plans; Eico scope 400; Simpson 260 multimeter; NRI 88 sig. gen.; Supreme radio manuals. Want firearms, power tools, sport equip. J. Earl Munson, Pembroke, Me.

FOR SALE — Radio and TV service business: supplies, equipment, service literature. State needs or send stamped envelope for list. L. A. Spriggs, 155 Wellington Ave., Washington, Pa.

WANTED — Recent sweep gen., not wired. Must be reasonable. State age, cond. and price. Philip P. Goldstein, 1162 E. 8th St., Brooklyn 30, N. Y.

FOR SALE — Completely wired Heathkit 0-6 scope, $40; Northeastern eng. model 700A sig. gen., $35. Both in exc. cond. with probes and manuals. Shipping extra. Frank Odziana, 18456 Gable, Detroit 34, Mich.

FOR SALE — Zenith portable radio 5-Band, Model 7G605, transoceanic. Needs slight repair, $35. H. Ursillo, 694 N. Broadway, E. Providence, R. I.

WANTED — Zenith transoceanic receiver and VTVM in trade for camera equip. E. DeCobert, 609 Henrietta St., Gillespie, Ill.

FOR SALE — Webster-Chicago "Webcor" 56-1 record changer, $20. Gabriel G. Speciale, 2737 Marion Ave., Bronx 58, N. Y.

SELL OR SWAP — VM-2 modulation xformer, $6.50; National HFS, Telerad freq. standard, $15 plus shipping. Will swap for test equip. or ham gear. W. J. Stange, 123 Bluff Ave., La Grange, Ill.

FOR SALE — Going TV business, complete test equip., building and living quarters. Write for details. Robert V. Betke, Ravenna, Neb.

SELL OR SWAP — CREI course "Introduction to Practical Radio Engineering," 20 lessons; "Advanced Practical Radio Engineering," 28 lessons, cost $98, sell for half or swap for good rifle telescope. J. Earl Mowry, 1245 S. Ogden, Denver 10, Colo.

WANTED — TS-323 freq. meter; Lampkin freq. meter, Lampkin modulation indicator; Bird (or similar) wattmeter. State price and condition. Stewart Babbitt, 9731 Rose Ave., Bellflower, Calif.

FOR SALE — West. Elec. 227B ship-to-shore radiophone complete with xtals; Continental motors 15 v. DC gas eng. gen.; TBY transceiver. All guaranteed. R. H. Ives, Rt. 2, Box 32, Lynnhaven, Va.

WANTED — Pickering model 230H preamp. Also matched set of air horns with compressor or type served by auxiliary air tank. James Littig, Box 203, Kasota, Minn.

FOR SALE — Hallicrafters xmitter, model HT9, power output 100W phone, 75WCW, self-contained AC power supply, l. n., $150. Progress Radio Supply Co., 413-415 Huron Rd., Cleveland 15, Ohio.

WANTED — All types rcvrs. and xmitters. Tom Allan, 159 Carlton Ave., Brooklyn 5, N. Y.

SELL OR SWAP — Sylvania Sweep Gen. for ham or Hi-Fi, or what have you? Lawrence J. Higgins, 115 Harrison Ct., W. Lafayette, Ind.

WANTED — TV picture tube type 12WP4 in usable condition. State price and cond., must be reasonable. Kenneth Bulgrien, Snover, Mich.

FOR SALE — Sm. stock and inv., rent $55 for sm. shop and living qtrs. in best US climate. Very good for elderly man. Write fully. "RADIO", Route 1, Box 76, Elsinore, Calif.

FOR SALE — Sams Photofacts 1-18 in binders, complete, l. n., $200; Stancor 752 battery eliminator, 6 v., 12.5 amps., l. n., $20; unused old-numbered receiving tubes, cheap. Calvin J. Evans, 327 West Spring St., LaGrange, Ind.

SELL OR SWAP — Radio, TV parts, manuals, etc. Want rec. tubes or what have you? Vincent Malack, 10530 Edbrooke Ave., Chicago 28, Ill.

SELL OR TRADE — 3 RK48A tubes with sockets, $15; UTC Varipower autoformer 1000 w., $7; Bendix '51 Form radio, $25; Mopar 824 '53 Dodge,Chrysler radio, $35. Need gas-driven power supply 110 v. AC, 60 cy., 350 w. min. B. A. Winterkorn, 175 Lake St., Waltham 54, Mass.

SELL OR TRADE — RCA 5527 Iconoscope; 500 tubes, parts plus test equip., i.e. Hickok model 125. L. F. Mach, 2051 Farnam St., Omaha, Neb.

FOR SALE — Like new 9LP7 9" scope tube, $5; rec. tubes, $170 list, $25. David A. Baker, 89 Walnut St., East Providence 14, R. I.

FOR SALE — Eico scope 425, sweep gen. 360 (factory calibrated, but never used). Both, $65, local only. Van Nest Radio-Television, 717 Morris Park Avenue, Bronx 62, N. Y.

WANTED — Good used tube tester, Simpson 1000 or 445, Hickok 600A or 605A and Hickok 650 or 650C Videometer also Sprague TO-4 condenser tester. Have Kilowatt ham rig, all bands. Don M. Lidenton, 701 Poplar St., Poplar Bluff, Mo.

FOR SALE — National HFS rcvr., with power supply; Eico 315 sig. gen.; Telrad 18A frequency standard. Make offer for any or all. Want Hickok 299X sig. gen., or Measurements model 80. Robert A. Jones, 1104 Newberry Ave., LaGrange Park, Ill.

FOR SALE — Riders 3-10, like new, any reasonable offer; GI record cutter and playback in carrying case, 33⅓ and 78 rpm, $22. Al Crispo, 85-02 133rd Ave., Ozone Park, N. Y.

SELL OR SWAP — Emerson and Zenith table model radios; Weber 35 mm. sound proj., amplifier can also be used as PA system; 30 high-speed drills. Want good used 16 mm. silent projector. Peter Calderaro, Elm St., Wakefield, Mass.

SELL OR SWAP — 12" TV sets in good cond., 1 kw AC gen., 5" 08 Heath scope. Need mobile equip., xmtr., rcvr., or anything in repairable cond. R. E. Stokes, Box 954, Staunton, Va.

SELL OR SWAP — Never used antique radio parts: tuning condensers, tube sockets, jacks, beautiful sets of knobs, no tubes. Trade for late model new tubes. Woodrow McHargue, Princeton, Mo.

FOR SALE — Klipsch Musicorner, rear loaded low freq. horn enclosure, grey finish, $35; University 6200 12" speaker, l. n., $14. N. R. Brenner, 92 Jane St., New York 14, N. Y.

WANTED — Lab equip. surplus "TS", General Radio, Ferris, etc., mfg. since 1942, any condition if repairable. Also recording milliammeter, polar coordinate type preferred. Details, price FOB first letter. T. M. Dale, Box 868 Portsmouth, N. H.

SELL OR SWAP — 6 vol. Coyne Applied Radio & TV books, l. n. Will swap for photo equip., etc. Bill Hagara, Slickville, Pa.

FOR SALE — Portable lab meters, Sensitrol relays, and multimeters. O. Hergenhan, 503 South 15th St., Newark 3, N. J.

FOR SALE — Viking VFO, Viking I TVI kit installed, and SX-71 receiver. Ralph Netzley, 479 South Julian St., Naperville, Ill.

SELL OR TRADE — G0-9 xmitter, ARC-5 with tuner, HO ~age trains, tubes, condensers, etc. Want Heathkit AT-1, Hallicrafters S-53A, S-53, S-38D, S-38C, SW-54, novice equip. W. I. Barry, c-o J. G. Biddle Co., 1316 Arch Street, Philadelphia 7, Pa.

SELL OR TRADE — DeForest radio home training course; Bud audio oscillator; 1000 v. DC 500 ma plate transformer 110 v. AC pri. Glynn P. McCready, 12345 N.E. Glisan, Portland 16, Ore.

FOR SALE — Meissner 8C FM tuner, plus extra stage of IF, walnut cabinet, l. n., $25 FOB. Paul Condry, 604 Garfield Ave., Springfield, Ill.

SELL OR SWAP — BC-375E trans.; 5 tuning units; ant. tuning unit; PE73C dynamotor; tubes, cables, manual, in orig. cartons. What have you? J. Mel, 455 Glen St., New Britain, Conn.

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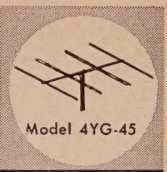
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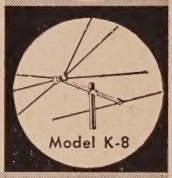
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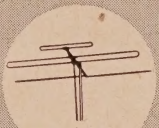
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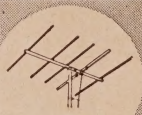
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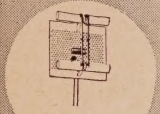
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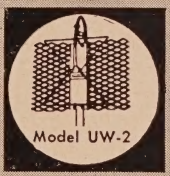
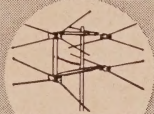

Model UW-2

Model UC-1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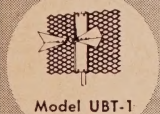
Model S-6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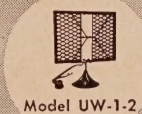
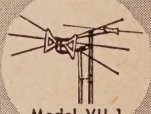

Model UW-1-2

Model UW-4

Model V-8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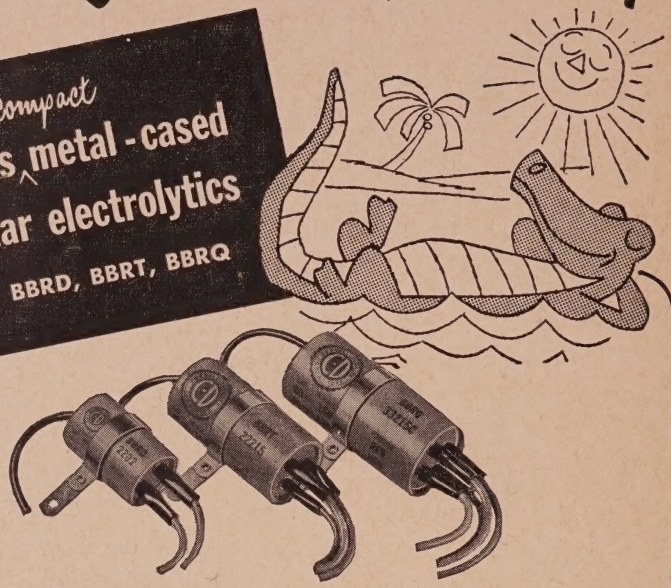

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